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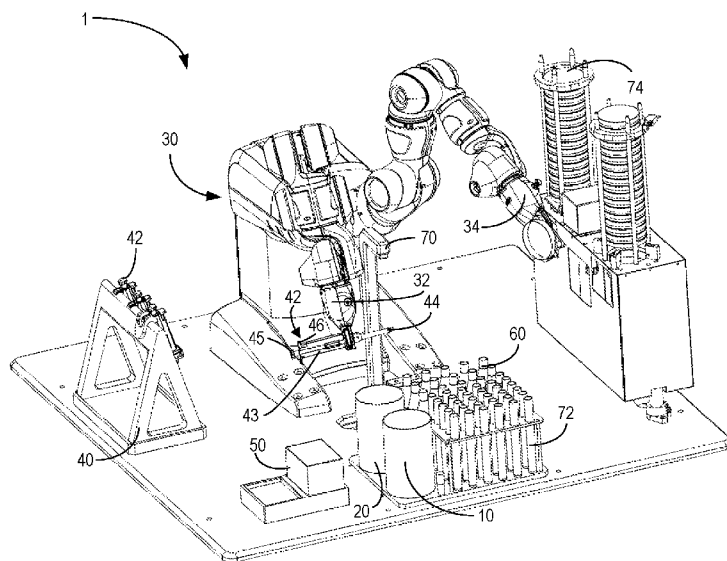


Fig. 1

(57) Abstract: A system (1) for diluting a sample and a corresponding method are provided. The system (1) comprises a first container (10) configured to contain the sample; a second container (20) arranged adjacent to the first container (10) and configured to contain a diluent; a third container (60) configured to receive the sample and the diluent to dilute the sample; a first support (40) configured to hold at least one pipette (42); and a robot (30) comprising a first arm (32) and a second arm (34), the first arm (32) and the second arm (34) being configured to operate the pipette (42) to transfer the sample from the first container (10) to the third container (60) or transfer the diluent from the second container (20) to the third container (60). The dilution of the sample can be carried out automatically by means of the robot (30) without human intervention.



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SYSTEM FOR DILUTING SAMPLE AND CORRESPONDING METHOD

FIELD

[0001] Example embodiments of the present disclosure generally relate to the field of laboratory sample pretreatment, and more particularly, to a system for diluting a sample and a corresponding method.

BACKGROUND

[0002] In the field of sample pretreatment in the laboratory, it is important in the dilution of the sample to obtain a sample with a different concentration gradient. The amounts of the sample and the diluent should be accurately controlled to ensure precise concentration of the diluted sample. The number of samples is large and the labor intensity is high. Moreover, some of the samples are infectious and may pose a health risk to the laboratory staff. Therefore, how to obtain the diluted sample in an efficient and safe manner remains a challenge.

SUMMARY

[0003] In general, example embodiments of the present disclosure provide a solution for efficiently diluting the sample with the diluent to obtain a sample with a precise concentration.

[0004] In a first aspect, there is provided a system for diluting a sample. The system comprises a first container configured to contain the sample; a second container arranged adjacent to the first container and configured to contain a diluent; a third container configured to receive the sample and the diluent to dilute the sample; a first support configured to hold at least one pipette; and a robot comprising a first arm and a second arm, the first arm and the second arm being configured to operate the pipette to transfer the sample from the first container to the third container or transfer the diluent from the second container to the third container.

[0005] According to embodiments of the present disclosure, the dilution of the sample can be carried out automatically by means of a robot without human intervention.

[0006] In some example embodiments, the pipette comprises a main body having a

first end and a second end opposite to the first end, and the system further comprises a second support configured to hold at least one pipette head, the pipette head being configured to be mounted onto the first end of the main body of the pipette. With these embodiments, the pipette head can be conveniently mounted to the main body of the pipette to facilitate the transfer of the sample or the diluent.

[0007] In some example embodiments, the first arm is further configured to clamp the main body of the pipette and move the main body to align with a corresponding pipette head, so as to mount the corresponding pipette head onto the first end of the main body of the pipette. With these embodiments, the assembly of the pipette head can be carried out in a convenient manner.

[0008] In some example embodiments, the main body further comprises a first button arranged at the second end, and the second arm is further configured to press the first button to exhaust air out of the main body and create a negative pressure inside the main body to suck the sample or the diluent. With these embodiments, the sample or the diluent can be sucked into the main body reliably.

[0009] In some example embodiments, the second arm is further configured to: after the sample or the diluent has been sucked up by the pipette, press the first button to squeeze the sample or the diluent out of the main body so as to transfer the sample or the diluent to the third container. In these embodiments, with the aid of the second arm, the sample or the diluent can be transferred to the third container and then mixed in the third container.

[0010] In some example embodiments, the system further comprises a column adjacent to the robot, the first arm is configured to align the pipette with the column, such that a second button on the main body of the pipette can hit the column to release the pipette head into a recovery device, the recovery device being configured to collect the pipette head which has been used to transfer the sample from the first container to the third container or transfer the diluent from the second container to the third container. With these embodiments, the pipette head can be replaced after use and then recycled into the recovery device. In this way, the potential damage to the laboratory staff can be prevented.

[0011] In some example embodiments, the system further comprises a fourth container

configured to receive the diluted sample from the third container, the first arm and the second arm are further configured to operate the pipette to transfer the diluted sample from the third container to the fourth container. With these embodiments, the diluted sample can be transferred to a desired container according to the requirement of the users.

5 [0012] In some example embodiments, the fourth container is a test tube without a lid. With these embodiments, the diluted sample can be transferred to the test tube for further processing.

[0013] In some example embodiments, the fourth container is a petri dish comprising a lid. With these embodiments, the diluted sample can be transferred to the petri dish
10 for further processing.

[0014] In some example embodiments, the system further comprises a platform arranged adjacent to the robot and configured to support the petri dish when transferring the diluted sample from the third container to the petri dish. With these embodiments, the petri dish can receive the diluted sample with the aid of the robot.

15 [0015] In a second aspect, there is provided a method of diluting a sample. The method comprises causing a first arm of a robot to clamp a pipette held by a first support; causing the first arm and a second arm of the robot to operate the pipette to transfer the sample from a first container containing the sample to a third container; and causing the first arm and the second arm to operate the pipette to transfer a diluent from a second
20 container containing the diluent to the third container. In these embodiments, a robot is used to dilute the sample, which reduces the inconsistency caused by the manual operation.

[0016] In some example embodiments, the pipette comprises a main body having a first end and a second end opposite to the first end, the method further comprises: causing
25 the first arm to clamp the main body and move the main body to align with a corresponding pipette head held by a second support, such that the corresponding pipette head is mounted onto the first end of the main body of the pipette. With these embodiments, the pipette head may be conveniently mounted to the main body of the pipette.

30 [0017] In some example embodiments, the main body further comprises a first button arranged at the second end, and transferring the sample comprises: causing the second

arm to press the first button to exhaust air out of the main body and create a negative pressure inside the main body to suck the sample; and after the sample has been sucked up by the pipette, causing the second arm to press the first button to squeeze the sample out of the main body so as to transfer the sample to the third container. With these
5 embodiments, the sample can be transferred to the third container in an effective manner.

[0018] In some example embodiments, the main body further comprises a first button at the second end, and transferring the diluent comprises: causing the second arm to press the first button to exhaust air out of the main body and create a negative pressure inside the main body to suck the diluent; after the diluent has been sucked up by the pipette,
10 causing the second arm to press the first button to squeeze the diluent out of the main body so as to transfer the diluent to the third container. With these embodiments, the diluent can be transferred to the third container in an effective manner to mix with the sample.

[0019] In some example embodiments, the method further comprises after transferring the sample, causing the first arm to align the pipette with a column adjacent to the robot,
15 such that a second button on the main body of the pipette can hit the column, so as to release the pipette head into a recovery device; and causing the first arm to move the main body to align with a further pipette head, such that the further pipette head is mounted onto the first end of the main body of the pipette. With these embodiments,
20 the used pipette head can be replaced efficiently.

[0020] In some example embodiments, the method further comprises after transferring the diluent, causing the first arm to align the pipette with a column adjacent to the robot, such that a second button on the main body of the pipette can hit the column, so as to release the pipette head into a recovery device, and causing the first arm to move the
25 main body to align with a further pipette head, such that the further pipette head is mounted onto the first end of the main body of the pipette. With these embodiments, the used pipette head can be replaced efficiently.

[0021] In some example embodiments, the method further comprises causing the first arm and the second arm to operate the pipette to transfer the diluted sample from the third
30 container to a fourth container. With these embodiments, the diluted sample can be transferred to a desired container according to the requirement of the users.

[0022] In some example embodiments, the fourth container is a test tube without a lid. With these embodiments, the diluted sample can be transferred to the test tube for further processing.

[0023] In some example embodiments, the fourth container is a petri dish comprising a lid. With these embodiments, the diluted sample can be transferred to the petri dish for further processing.

[0024] In some example embodiments, the method further comprises causing the second arm to clamp the petri dish and move the petri dish onto a platform arranged adjacent to the robot; causing the second arm to release the petri dish; and causing the second arm to press the first button to squeeze the diluted sample out of the main body to transfer the diluted sample to the petri dish. With these embodiments, the movement of the petri dish and also the transfer of the diluted sample can be achieved in a reasonable manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Through the following detailed description with reference to the accompanying drawings, the above and other objectives, features and advantages of the example embodiments disclosed herein will become more comprehensible. In the drawings, several example embodiments disclosed herein will be illustrated in an exemplary and in a non-limiting manner, wherein:

[0026] Fig. 1 illustrates a perspective view of a system for diluting a sample in accordance with an example embodiment of the present disclosure;

[0027] Fig. 2 illustrates a perspective view of the system as shown in Fig. 1 when being viewed from another direction; and

[0028] Fig. 3 illustrates a top view of the system as shown in Fig. 1.

[0029] Throughout the drawings, the same or similar reference numerals represent the same or similar element.

DETAILED DESCRIPTION

[0030] Principles of the present disclosure will now be described with reference to

some example embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and to help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein can be implemented in various manners other than the ones described below.

[0031] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs.

[0032] References in the present disclosure to “one embodiment,” “an embodiment,” “an example embodiment,” and the like indicate that the embodiment described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to apply such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0033] It should be understood that although the terms “first” and “second” etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and similarly, a second element could be termed a first element, without departing from the scope of example embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

[0034] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/ or combinations thereof.

[0035] As mentioned above, the pretreatment of the sample in the laboratory requires high labor intensity. Therefore, the possibility of manual error is relatively high due to the complicated procedures, such that the consistency of the sample cannot be guaranteed. Moreover, some samples are infectious and are thus harmful to the health of the laboratory staff.

[0036] According to embodiments of the present disclosure, a robot can be used to dilute the sample with an accurate concentration and transfer the diluted sample to a desired container, which does not require the intervention of a human.

[0037] Example embodiments will be described in more detail hereinafter with reference to Figs. 1-3.

[0038] Figs. 1-3 illustrate schematic views of a system 1 for diluting a sample in accordance with an example embodiment of the present disclosure. The system 1 as illustrated generally includes a first container 10, a second container 20 and a third container 60. The first container 10 is configured to contain the sample. The sample can be of various types, which may be determined according to the actual need of the users. As shown in Figs. 1-3, the second container 20 is arranged adjacent to the first container 10 and may be used to contain a diluent. In some example embodiments, the diluent may be water. It is to be understood that the materials of the diluent are merely exemplary, without suggesting any limitation as to the scope of the present disclosure. The third container 60 is configured to receive the sample and the diluent. The sample and the diluent are mixed within the third container 60, such that the sample can be diluted.

[0039] As illustrated in Figs. 1-3, the system 1 further includes a first support 40 which is configured to hold at least one pipette 42. The pipette 42 may be operated by a first arm 32 and a second arm 34 of a robot 30 to transfer the sample from the first container 10 to the third container 60. The pipette 42 may also be operated by the first arm 32 and the second arm 34 to transfer the diluent from the second container 20 to the third container 60.

[0040] According to embodiments of the present disclosure, by means of the first arm 32 and the second arm 34 of the robot 30, both the sample and the diluent can be transferred to third container 60. During the transferring procedure, no human labor is

needed. In this way, the dilution of the sample can be carried out in a pollution-free environment.

[0041] In some example embodiments, the amounts of the sample and the diluent can be predetermined to obtain a diluted sample with a desired concentration.

5 **[0042]** In some example embodiments, as shown in Fig.1, the pipette 42 may generally include a main body 43 and a pipette head 44. The main body 43 may have a first end and a second end opposite to the first end. In the illustrated embodiment, the system 1 may further include a second support 50, which is configured to hold at least one pipette head 44. The pipette head 44 held by the second support 50 is new and
10 clean and is ready to replace the used pipette head 44 attached to the main body 43 of the pipette 42. The pipette head 44 is configured to be mounted onto the first end of the main body 43 of the pipette 42. In this way, the pipette head 44 may be replaced after use to ensure that the sample and the diluent in a next diluting procedure will not be contaminated.

15 **[0043]** In some example embodiments, the first arm 32 may be further configured to clamp the main body 43 of the pipette 42 and move the main body 43 to align with a corresponding pipette head 44, so as to mount the corresponding pipette head 44 onto the first end of the main body 43 of the pipette 42. In this way, the assembling of the main body 43 and the pipette head 44 can be achieved in a convenient manner.

20 **[0044]** In some example embodiments, as illustrated in Figs. 1-3, the main body 43 may further include a first button 45, which is arranged at the second end of the main body 43. The second arm 34 is further configured to press the first button 45 to exhaust air out of the main body 43 and create a negative pressure inside the main body 43. In this way, the sample or the diluent can be sucked into the main body 43.

25 **[0045]** In some example embodiments, after the sample or the diluent has been sucked up by the pipette 42, when the main body 43 of the pipette 42 is operated by the first arm 32 to a position adjacent the third container 60, the second arm 34 may press the first button 45 again to squeeze the sample or the diluent out of the main body 43 to the third container 60. In this way, the sample or the diluent can be transferred to the third
30 container 60.

[0046] In some example embodiments, the system 1 may further include a column 70

adjacent to the robot 30. As shown in Figs. 1-3, the main body 43 of the pipette 42 may further include a second button 46, which is used to facilitate the release of the pipette head 44. In some example embodiments, the first arm 32 is configured to move the pipette 42 to align it with the column 70, such that the second button 46 can hit the column 70 to release the pipette head 44 from the main body 43 of the pipette 42 into a recovery device (not shown). The recovery device is configured to collect the pipette head 44 which has been used to transfer the sample from the first container 10 to the third container 60 or transfer the diluent from the second container 20 to the third container 60. Afterwards, the pipette 42 may be operated by the first arm 32 to align with a new pipette head 44 held by the second support 50, so as to mount the corresponding pipette head 44 onto the first end of the main body 43 of the pipette 42.

[0047] In some example embodiments, the third container 60 may be a temporary container used for mixing and dilution. The system may further include a fourth container configured to receive the diluted sample from the third container 60. The fourth container may be used to store the diluted sample for a long time. In some example embodiments, as shown in Fig. 1, the fourth container may be a test tube 72 without a lid. In another example embodiment, the fourth container is a petri dish 74 with a lid. The specific type of the fourth container can be determined according to the actual need of the user. The first arm 32 and the second arm 34 may be further configured to operate the pipette 42 to transfer the diluted sample from the third container 60 to the fourth container. The sample may further be transferred to a final container according to the actual need of the users.

[0048] In some example embodiments, as shown in Figs. 2 and 3, the system 1 may further include a platform 80 arranged adjacent to the robot 30. The platform 80 may be configured to support the petri dish 74. The second arm 34 may be configured to move the petri dish 74, with the lid being removed, onto the platform 80 and then press the first button 45 to squeeze the diluted sample out of the main body 43 so as to transfer the diluted sample from the third container 60 to the petri dish 74. In this way, by simply using the second arm 34, the petri dish 74 may be moved and be injected with the diluted sample.

[0049] In some example embodiments, the task instruction may be sent to the robot 30 remotely from the laboratory staff. The task instruction may include the amount of the

sample and the corresponding diluent. Therefore, a hygienic isolation may be obtained to maintain the safety of both the laboratory staff and the sample. Moreover, since each operation of the robot 30 can be recorded and stored, if an error occurs, the laboratory staff may trace back and find out the reason for the error. Thus, the traceability of the system 1 may be achieved.

[0050] Compared with the conventional manual operation, with the aid of the robot 30, the automation and intelligence of laboratory processes can be achieved.

[0051] In a second aspect, there is provided a method of diluting a sample. The method includes causing the first arm 32 of the robot 30 to clamp the pipette 42 held by the first support 40. The method further includes causing the first arm 32 and the second arm 34 of the robot 30 to operate the pipette 42 to transfer the sample from the first container 10 to a the third container 60. Afterwards, the method further includes causing the first arm 32 and the second arm 34 to operate the pipette 42 to transfer the diluent from the second container 20 to the third container 60. In this way, the sample and the diluent can be mixed in the third container 60.

[0052] In some example embodiments, the method may further include causing the first arm 32 to clamp the main body 43 and move the main body 43 to align with a corresponding pipette head 44 held by the second support 50, such that the corresponding pipette head 44 can be mounted onto the first end of the main body 43 of the pipette 42.

[0053] In some example embodiments, transferring the sample may further include causing the second arm 34 to press the first button 45 to exhaust air out of the main body 43 and create a negative pressure inside the main body 43 to suck the sample. In some example embodiments, after the sample has been sucked up by the pipette 42, the method may further include causing the second arm 34 to press the first button 45 to squeeze the sample out of the main body 43 so as to transfer the sample to the third container 60.

[0054] In some example embodiments, after transferring the sample to the third container 60, the pipette 42 may be moved by the first arm 32 to align with the column 70 adjacent to the robot 30, such that the second button 46 on the main body 43 of the pipette 42 can hit the column 70, so as to release the pipette head 44 from the main body 43 into the recovery device. Afterwards, the first arm 32 is operated to move the main body 43 of pipette 42 to align with a further pipette head 44 held by the second support

50, such that the further pipette head 44 is mounted onto the first end of the main body 43 of the pipette 42.

[0055] In some example embodiments, transferring the diluent may further include causing the second arm 34 to press the first button 45 to exhaust air out of the main body 43 and create a negative pressure inside the main body 43 to suck the diluent. In some example embodiments, after the diluent has been sucked up by the pipette 42, the method may further include causing the second arm 34 to press the first button 45 to squeeze the diluent out of the main body 43 so as to transfer the diluent to the third container 60.

[0056] In some example embodiments, after transferring the diluent to the third container 60, the pipette 42 may be moved by the first arm 32 to allow the second button 46 on the main body 43 of the pipette 42 to hit the column 70, to release the pipette head 44 from the main body 43. Afterwards, the first arm 32 is operated to move the main body 43 of pipette 42 to align with a further pipette head 44 to allow the further pipette head 44 to be mounted onto the first end of the main body 43 of the pipette 42.

[0057] In some example embodiments, the method may further include causing the first arm 32 and the second arm 34 to operate the pipette 42 to transfer the diluted sample from the third container 60 to the fourth container.

[0058] In some example embodiments, after transferring the diluted sample to the fourth container 60, the pipette 42 may be moved to allow the second button 46 on the main body 43 to hit the column 70, to release the pipette head 44 into the recovery device. Afterwards, the first arm 32 is operated to move the main body 43 of pipette 42 to align with a further pipette head 44 to allow the further pipette head 44 to be mounted onto the first end of the main body 43 of the pipette 42.

[0059] In some example embodiments, the method further includes causing the second arm 34 to clamp the petri dish 74 and move the petri dish 74 onto the platform 80 arranged adjacent to the robot 30. Afterwards, the method further includes causing the second arm 34 to release the petri dish 74. The method further includes causing the second arm 34 to press the first button 45 to squeeze the diluted sample out of the main body 43 to transfer the diluted sample to the petri dish 74.

[0060] Further, while operations are depicted in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown

or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Likewise, while several specific implementation details are contained in the above discussions, these should not be construed as limitations on the scope of the present disclosure, but rather as descriptions of features that may be specific to particular embodiments.

[0061] Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims

WHAT IS CLAIMED IS:

1. A system (1) for diluting a sample, comprising:

a first container (10) configured to contain the sample;

5 a second container (20) arranged adjacent to the first container (10) and configured to contain a diluent;

a third container (60) configured to receive the sample and the diluent to dilute the sample;

a first support (40) configured to hold at least one pipette (42); and

10 a robot (30) comprising a first arm (32) and a second arm (34), the first arm (32) and the second arm (34) being configured to operate the pipette (42) to transfer the sample from the first container (10) to the third container (60) or transfer the diluent from the second container (20) to the third container (60).

15 2. The system (1) of claim 1, wherein the pipette (42) comprises a main body (43) having a first end and a second end opposite to the first end, and

wherein the system (1) further comprises a second support (50) configured to hold at least one pipette head (44), the pipette head (44) being configured to be mounted onto the first end of the main body (43) of the pipette (42).

20 3. The system (1) of claim 2, wherein the first arm (32) is further configured to clamp the main body (43) of the pipette (42) and move the main body (43) to align with a corresponding pipette head (44), so as to mount the corresponding pipette head (44) onto the first end of the main body (43) of the pipette (42).

25 4. The system (1) of claim 2, wherein the main body (43) further comprises a first button (45) arranged at the second end, and

wherein the second arm (34) is further configured to press the first button (45) to exhaust air out of the main body (43) and create a negative pressure inside the main body (43) to suck the sample or the diluent.

5. The system (1) of claim 4, wherein the second arm (34) is further configured to:

after the sample or the diluent has been sucked up by the pipette (42), press the first button (45) to squeeze the sample or the diluent out of the main body (43) so as to transfer

the sample or the diluent to the third container (60).

6. The system (1) of claim 2, further comprising a column (70) adjacent to the robot (30),

5 wherein the first arm (32) is configured to align the pipette (42) with the column (70), such that a second button (46) on the main body (43) of the pipette (42) can hit the column (70) to release the pipette head (44) into a recovery device, the recovery device being configured to collect the pipette head (44) which has been used to transfer the sample from the first container (10) to the third container (60) or transfer the diluent from the
10 second container (20) to the third container (60).

7. The system (1) of claim 1, further comprising a fourth container configured to receive the diluted sample from the third container (60),

15 wherein the first arm (32) and the second arm (34) are further configured to operate the pipette (42) to transfer the diluted sample from the third container (60) to the fourth container.

8. The system (1) of claim 7, wherein the fourth container is a test tube (72) without a lid.

20 9. The system (1) of claim 7, wherein the fourth container is a petri dish (74) comprising a lid.

10. The system (1) of claim 9, further comprising:
25 a platform (80) arranged adjacent to the robot (30) and configured to support the petri dish (74) when transferring the diluted sample from the third container (60) to the petri dish (74).

11. A method of diluting a sample, comprising:
30 causing a first arm (32) of a robot (30) to clamp a pipette (42) held by a first support (40);

causing the first arm (32) and a second arm (34) of the robot (30) to operate the pipette (42) to transfer the sample from a first container (10) containing the sample to a third container (60); and

causing the first arm (32) and the second arm (34) to operate the pipette (42) to transfer a diluent from a second container (20) containing the diluent to the third container (60).

5 12. The method of claim 11, wherein the pipette (42) comprises a main body (43) having a first end and a second end opposite to the first end,

wherein the method further comprises:

causing the first arm (32) to clamp the main body (43) and move the main body (43) to align with a corresponding pipette head (44) held by a second support (50), such that the
10 corresponding pipette head (44) is mounted onto the first end of the main body (43) of the pipette (42).

13. The method of claim 12, wherein the main body (43) further comprises a first button (45) arranged at the second end, and

15 wherein transferring the sample comprises:

causing the second arm (34) to press the first button (45) to exhaust air out of the main body (43) and create a negative pressure inside the main body (43) to suck the sample; and

20 after the sample has been sucked up by the pipette (42), causing the second arm (34) to press the first button (45) to squeeze the sample out of the main body (43) so as to transfer the sample to the third container (60).

14. The method of claim 12, wherein the main body (43) further comprises a first button (45) at the second end, and

25 wherein transferring the diluent comprises:

causing the second arm (34) to press the first button (45) to exhaust air out of the main body (43) and create a negative pressure inside the main body (43) to suck the diluent;

30 after the diluent has been sucked up by the pipette (42), causing the second arm (34) to press the first button (45) to squeeze the diluent out of the main body (43) so as to transfer the diluent to the third container (60).

15. The method of claim 12, further comprising:

after transferring the sample,

causing the first arm (32) to align the pipette (42) with a column (70) adjacent to the robot (30), such that a second button (46) on the main body (43) of the pipette (42) can hit the column (70), so as to release the pipette head (44) into a recovery device; and

causing the first arm (32) to move the main body (43) to align with a further
5 pipette head (44), such that the further pipette head (44) is mounted onto the first end of the main body (43) of the pipette (42).

16. The method of claim 12, further comprising:

after transferring the diluent,

10 causing the first arm (32) to align the pipette (42) with a column (70) adjacent to the robot (30), such that a second button (46) on the main body (43) of the pipette (42) can hit the column (70), so as to release the pipette head (44) into a recovery device, and

causing the first arm (32) to move the main body (43) to align with a further
15 pipette head (44), such that the further pipette head (44) is mounted onto the first end of the main body (43) of the pipette (42).

17. The method of claim 12, further comprising:

causing the first arm (32) and the second arm (34) to operate the pipette (42) to
20 transfer the diluted sample from the third container (60) to a fourth container.

18. The method of claim 17, wherein the fourth container is a test tube (72) without
a lid.

19. The method of claim 17, wherein the fourth container is a petri dish (74)
25 comprising a lid.

20. The method of claim 19, further comprising:

causing the second arm (34) to clamp the petri dish (74) and move the petri dish (74)
onto a platform (80) arranged adjacent to the robot (30);

30 causing the second arm (34) to release the petri dish (74); and

causing the second arm (34) to press the first button (45) to squeeze the diluted
sample out of the main body (43) to transfer the diluted sample to the petri dish (74).

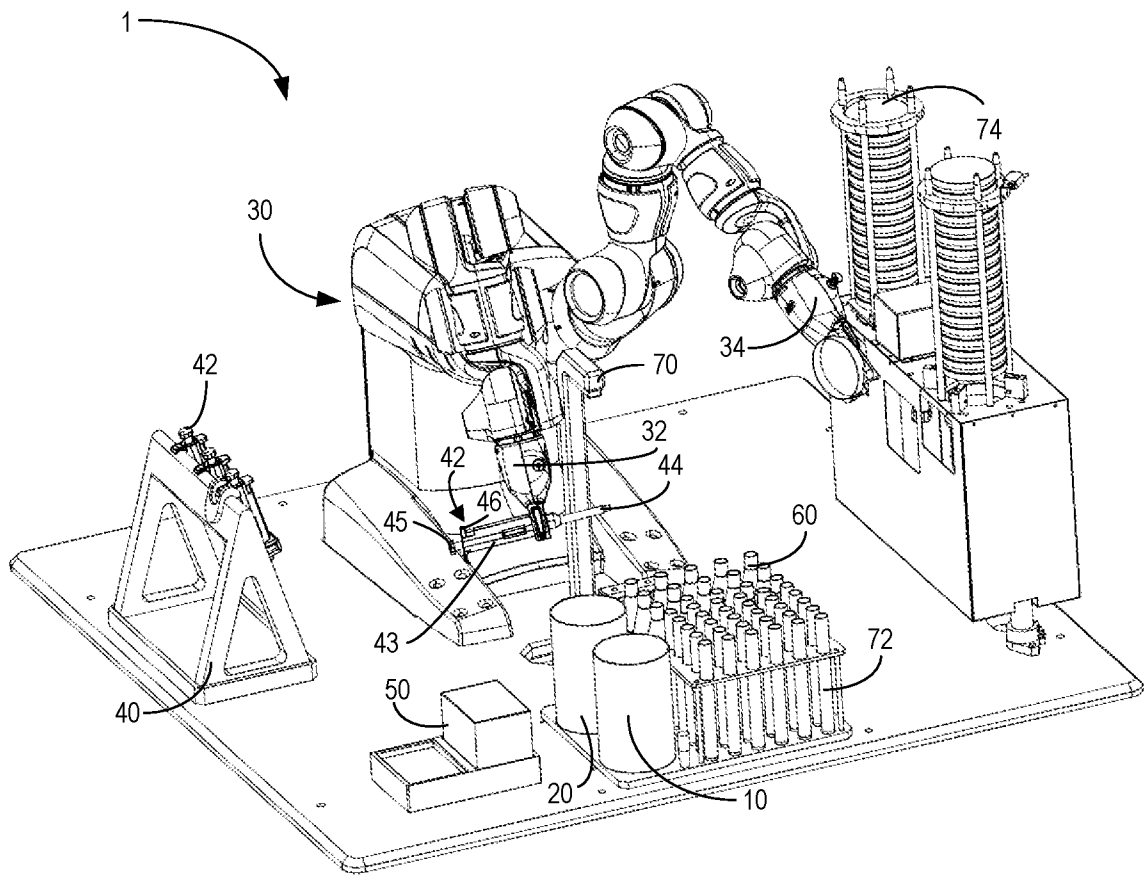


Fig. 1

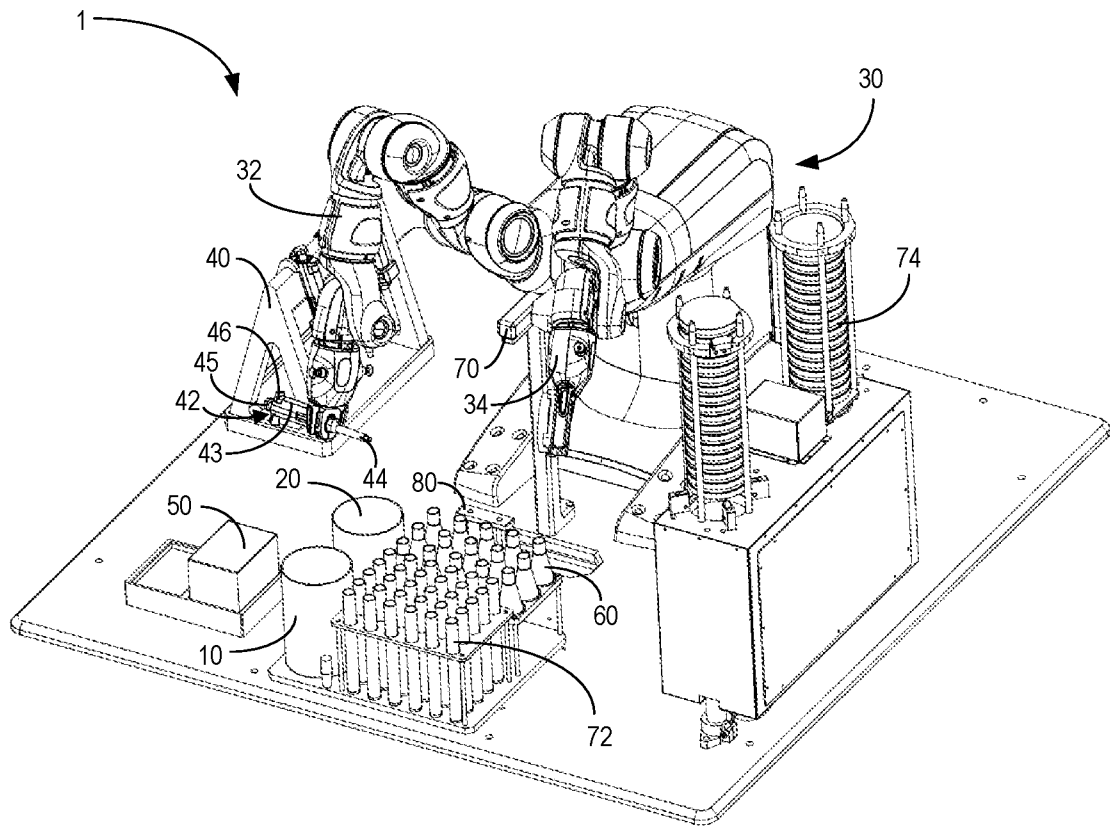


Fig. 2

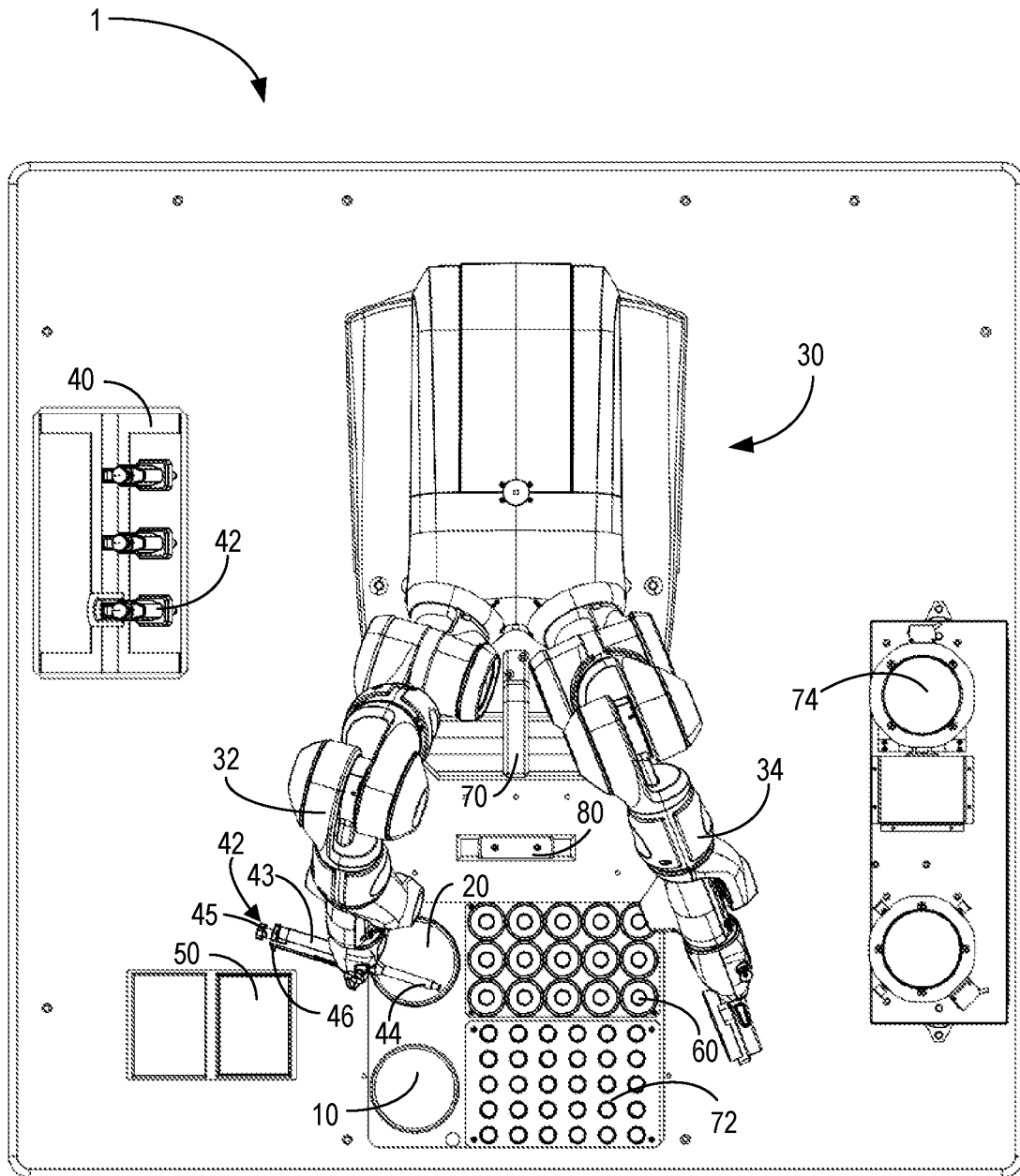


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/080365

A. CLASSIFICATION OF SUBJECT MATTER

G01N 1/28(2006.01)i; G01N 1/38(2006.01)i; G01N 1/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01N,B01L,A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI,CNPAT,WPI,EPDOC: transfer+, liquid, sampl+, dilut+, diluent, pipette, pipettor, container, detect+, test???, tube?, pipe?, arm?, suck???, replac???, disassembl+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111644218 A (SHANGHAI MEDIACENTER BIOTECHNOLOGY CO., LTD.) 11 September 2020 (2020-09-11) description paragraphs [0002]-[0008], [0015]-[0024]、figure 1	1-20
X	CN 106840797 A (SHANGHAI SCIWAY MEDICAL TECH. CO., LTD.) 13 June 2017 (2017-06-13) description paragraphs [0003]-[0005], [0030], [0035]-[0040]、figures 1-3	1-20
X	CN 205157561 U (ZHONGSHAN SHENGKE REAGENT APPARATUS CO., LTD.) 13 April 2016 (2016-04-13) description paragraphs [0026]-[0048], figures 1-3	1-20
A	CN 210487593 U (SICHUAN ZHONGHUAN TESTING CO., LTD.) 08 May 2020 (2020-05-08) the whole document	1-20
A	CN 208766037 U (HEBEI ZHONGJIANZHIXING INSTR. AND METER CO., LTD.) 19 April 2019 (2019-04-19) the whole document	1-20
A	US 2004054286 A1 (GLAXO GROUP LTD. et al.) 18 March 2004 (2004-03-18) the whole document	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

20 November 2021

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/080365

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	111644218	A	11 September 2020	None			
CN	106840797	A	13 June 2017	None			
CN	205157561	U	13 April 2016	None			
CN	210487593	U	08 May 2020	None			
CN	208766037	U	19 April 2019	None			
US	2004054286	A1	18 March 2004	WO	02079751	A2	10 October 2002
				EP	1365855	A2	03 December 2003